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ON SOLUTIONS
OF
GUN-COTTON, GUTTA PERCHA, AND
CAOUTCHOUC,
AS
DRESSINGS FOR WOUNDS, ETC.

Read before the Edinburgh Medico-Chirurgical Society,

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(From the London Medical Gazette.)

[It is only due to Professor Simpson to state that, a subject which has recently attracted great attention—namely, the employment of new adhesive preparations in surgery, was made known by him to the Edinburgh Medico-Chirurgical Society in May last. We reprint from a recent number of the Edinburgh Monthly Journal, the following account of his observations and experiments, including those of Mr. Maynard and Dr. Bigelow, in the United States.]

At different periods in the history of surgery, very different practices have prevailed in regard to the treatment of wounds. At one time, in injuries or incisions of any great extent, the whole sides of the divided or cut surfaces were dressed as separate and distinct wounds; and all chance of immediate union prevented. Slow reunion by suppuration and granulation, or, as the old surgeons termed it, by “digesting, mundrying, and incarning” wounds, was alone attempted. Afterwards, however, and yet not without much doubt and opposition,* the practice was introduced of placing from the first the sides and lips of the wound in contact, and

thus allowing nature to produce the spontaneous adhesion of the whole wound, or as much of its surfaces as will thus adhere. In other words, reunion by the first intention came to be more and more attempted *after* the discovery of the doctrine of adhesion (as it was termed) was duly made and fully acted on.

But no small difference of opinion and practice has prevailed as to the best mode of bringing and retaining in contact the sides of such wounds as are capable of healing by the first intention. A great variety of bandages, plasters, needles, and stitches, have been invented for this purpose. And, the propriety or non-propriety of using sutures in preference to plasters (the *sutura cruenta*, as it was termed, in preference to the *sutura sicca*), was at one time a special subject of dispute. Louis, Pibrac, and Young, maintained that in all, or in almost all, cases, the employment of the suture should be abandoned as irritating and hurtful. At the present day, both modes of artificial reunion—the *sutura cruenta* and *sicca*—are followed by the generality of surgeons; and often both modes are used simultaneously.

It seems not at all improbable, that another step in advance will betimes be effected, and that surgeons will be enabled to apply to the wound, after its edges are brought in contact, some material or other which, like an artificial plasma, or lute of coagulable lymph, will at one and the same time serve the following purposes:—

1. It will be sufficiently strong and ad-

* “I would ask (gravely writes O’Halloran in 1765), I would ask the most ignorant in our profession, whether he ever saw or heard even of a wound, though no more than one inch long, united in so short a time (as three days). These tales are told with more confidence than veracity; healing by inoculation, by the first intention, by immediate coalescence without suppuration, is merely chimerical, and opposite to the rules of nature.”

hesive to retain the edges of the wound together, without the irritation sometimes following the use and removal of sutures or pins;

2. It will serve as a perfect dressing to the wound.

3. It will, however, not be soluble in water, or be easily removed: and hence will enable the surgeon to apply cold, &c., to restrain and modify the action in the wound, if required.

4. Though insoluble in water, the material used must be soluble in some menstruum that is easily and readily vaporized.

5. It will be applied in a fluid or semi-fluid form, and be thus capable of adapting itself to any irregularity in the edges of the wound or in the neighbouring cutaneous surface; the fluid part evaporating speedily on exposure, and a solid tissue or substance, possessing sufficient tenacity, adhesiveness, and insolubility in water for the above purposes, being left like a plaster on the edges of the united wound.

The intention of the present imperfect communication is to bring before the Society some of the attempts lately made in order to attain the above objects.

Two or three weeks ago, it was announced in our weekly medical journals, that a solution of gun-cotton in ether had been used in America as a dressing for wounds; and, within the last two or three days, the American journals which have arrived in Edinburgh show that the suggestion of this practice is claimed by two different persons, viz. by Mr. Maynard, a medical student of Boston, and by Dr. Bigelow, of the same city.

Soon after the discovery of gun-cotton or pyroxyline, Schoenbein and Boettger showed that acetic ether was one of its best solvents.—(*Chemical Gazette* for April 1, 1847.) Richner had ascertained that it was entirely soluble in the acetic ethers both of alcohol and wood spirit.—(*Ib.* for February 1.) When xyloidine, or the analogous compound made by the action of nitric acid on starch, is dissolved in ether, or ether and alcohol, Schoenbein found that it was reduced to a colourless gelatinous mass, and that, if spread upon a smooth surface, "*it left a dull white opaque membrane.*"—(*Ib.* for April 1.) I am not aware whether he has recorded any similar observation regarding the ethereal solution of pyroxyline, but it is this quality of it that has been turned in America to practical purposes as an application and dressing for wounds.

When gun-cotton is fully dissolved in strong sulphuric ether, it forms a semi-transparent gelatinous pulp. When a layer of this is laid on any surface, the ether speedily evaporates, and leaves an adherent whitish, cotton-like web, which contracts strongly as it dries, and possesses still all

the usual inflammable and explosive properties of gun-cotton. In a great variety of trials which I have had made as to the best mode of forming the solution, I have met with very various results. Many of these variations were probably owing to imperfections and differences, either in the quality of the gun-cotton or of the ether. But occasionally, with the same ingredients, the quality of the solution seemed liable to differ. Sometimes after the gun-cotton had been immersed in the ether for ten or twelve hours without much effect, the addition of a little strong spirit immediately effected a perfect solution. The gun-cotton often possesses strong adhesive properties when used before it is all completely dissolved. In using as a solvent, aldehyde, which had been kept for a considerable time, I found a perfect pulpy solution formed in a few minutes. If it could be used as a menstruum, it would possess the advantage of being even more vaporizable than ether. But in trying to repeat the experiment with some aldehyde newly formed for the purpose, the same results were not obtained.

Usually an ounce of strong sulphuric ether will dissolve thirty grains or more of gun-cotton in the course of a few hours. But to form a complete pulp it will in general require to stand for a day. The advantages which the ethereal solution of gun-cotton seems to possess as a dressing for wounds, and particularly for those which it is desired to unite by the first intention, are stated in the following terms by Dr. Bigelow:—

"1st. By its powerful contraction upon evaporation it places the edges of an incised wound in much more intimate contact than is obtained by sutures and adhesive cloth—unites them by equal pressure throughout the whole extent of the wound, and maintains them immoveably fixed. 2d. It preserves the wound perfectly from contact with air, being impermeable to the atmosphere, while its adhesion to the skin is so intimate as to preclude the possibility of air entering beneath the edges. 3d. The substance remaining in contact with the skin and wound after the evaporation of the ether, seems to be entirely inert, so far as any irritating property is concerned, and this can scarcely be said of any resinous adhesive cloth or preparation. 4th. It does away with the necessity for sutures in incised wounds of almost any extent. 5th. It is sure to remain in intimate contact with the skin till union is complete, and being quite impervious to water, and presenting a polished surface, it allows the surrounding parts to be washed without regard to the wound or dressing. 6th. It is colourless and transparent, thus permitting the surgeon to witness all that goes on beneath without involving the necessity for its removal. 7th. No heat is neces-

sary for its application, and the presence of any moderate degree of cold is only objectionable in retarding the evaporation of the ether. 8th. It may be made at a trifling cost; an ounce phial, intrinsically worth little, being sufficient for a great number of dressings."

The adhesive power of this solution of gun-cotton is, when properly made and applied, certainly very great. In evidence of its strong adhesive powers, Mr. Maynard states the following experiments:—"He glued a strap of sheepskin to the hand by a thin layer of the solution, nine lines long and one and a half wide, and it sustained a weight of two pounds. A second strap attached to the hand by a layer of the substance, nine lines in length and three in width, sustained a weight of three. A third strap fixed to the hand by a layer of the liquid, twelve lines square, resisted the force of ten pounds without giving way; and a fourth strap of the leather glued to the hand by a stratum of the solution, measuring one and three-fourths of an inch in length and one in width, was not separated from its attachment by the gravity of twenty pounds!" These statements, says Mr. Maynard, may appear incredible, but they are founded on exact and carefully-performed experiments.

As to the mode of applying the ethereal solution of gun-cotton, Mr. Maynard states, that "In slight cuts a moderately thick coating of the solution, laid over the incised parts, was, on becoming dry, sufficient to keep the lips of the wound in position till union took place; but in most instances it was employed in conjunction with straps of cotton and sheepskin, and with raw cotton, forming with them strong, unyielding, adhesive straps, bandages, and encasements: and, after many experiments, I am convinced that this is the best and most effectual way in which it can be employed as an adhesive agent in surgery. The solution dries rapidly, and in a few seconds; by the evaporation of the ether it contains, it becomes solid and impermeable to water; and a strap moistened with it, and glued to any part of the cutaneous surface, adheres to it with a tenacity that is truly surprising." Mr. Maynard mentions one case in which, after the removal of a tumor from the scalp, the hair in the neighbourhood was shaved, and two pieces of sheepskin were firmly sealed, by the solution of gun-cotton, to each side of the wound at a distance from the edges, and then these edges were approximated and retained in contact by passing stitches through the dead sheepskin instead of passing sutures through the living tissues of the walls of the wound.

Dr. Bigelow's directions for applying the gun-cotton solution are as follows:—"For

straight incisions, of *whatever length*, provided the edges can be brought together without great difficulty, it is better to apply the solution in immediate contact with the skin, as follows:—"The bleeding should be arrested, and the skin thoroughly dried. If the lips of the wound are themselves in contact, the surgeon has only to apply a coating of the solution lengthwise over the approximated edges by means of a camel's hair pencil, leaving it untouched after the brush has once passed over it till it is dry, during perhaps ten or twenty seconds. This first film will of itself have confined the edges together; but, in order to increase the firmness of the support, more must then be applied in the same manner, allowing it to extend on either side of the incision half an inch or more. If, however, the wound gapes, an assistant is required to bring the edges in contact, and retain them so whilst the application is made. If the incision is so long that the assistant cannot place the edges in apposition throughout the whole extent, begin by covering a small portion at the upper end, and apply the solution to the lower parts as fast as it becomes dry above. In this case something more than the film which is left adherent to the skin will be necessary for a safe and proper support to the wound, which may have a tendency to separate. The transparency of the dressing may be still maintained by adapting a piece of goldbeater's skin or oiled silk to the wound. This should be covered with the solution, and the membrane applied after the coating is on and already contracted. A dossil of lint, or a strip of cloth, or even a piece of tissue paper, which is thus rendered tough and waterproof, will answer the same purpose, though not transparent. Where there is much separation, it is better to fortify the wound in this way at once, and as fast as the first coating is applied and dry. 'If, however, adhesion by first intention be not desired, the gum may be painted on in transverse strips, like adhesive cloth, letting the first strip dry, and giving it the goldbeater's skin support before the second is applied. Thus room is left for the escape of pus, and the exposed portion may be watched without removing the strips.'"

It has been proposed to use the ethereal solution of gun-cotton for other purposes than the dressing and union of wounds—as, for example, as a substitute for the starch bandage in fractures; as an application and dressing to ulcers, &c. In abrasions, and slight injuries of the skin about the fingers, it forms an excellent and most adhesive dressing. There is one extremely painful and unmanageable form of ulcer in which I applied it eight or ten days ago, at the Maternity Hospital, with perfect success. I allude to fissures at the base of the nipple. Most

practitioners know well the agony that some mothers undergo, in consequence of this apparently slight disease; the ulcer or fissure being renewed and torn open with each application of the child. In two such cases I united the edges of the fissures, and covered them over with the solution of gun-cotton, making the layer pretty strong. It acted successfully, by maintaining the edges so firmly together that they were not again re-opened by the infant: the gun-cotton dressing was not, like other dressings, affected by the moisture of the child's mouth; and as a dressing, and at the same time securing rest to the part, it allowed complete adhesion and cicatrization speedily to take place. I have applied it also repeatedly to ulcers of the cervix uteri and over various cutaneous eruptions. Its application relieves at once the smarting of slight burns.

In a case in which Professor Miller lately removed a large portion of necrosed bone from the lower jaw, I dressed the lips of the incision with the gun-cotton solution, and it held them for some days subsequently accurately in contact till adhesion took place. In two minor amputations (one of the finger and the other of the toe), by the same gentleman, it was applied, but required to be removed in a day or two, in consequence of its retaining the discharges. I have made a number of experiments, with solutions in different menstrua, of various other substances besides gun-cotton, especially viscine, dextrine, caoutchouc, and gutta-percha.

Gutta-percha readily, I find, dissolves in chloroform. When a thin layer of this solution is spread upon the skin or any other surface, the chloroform rapidly evaporates, and leaves a film or web of gutta-percha, possessing all the tenacity and other properties of that substance. A layer of it, of the thickness of good writing-paper, has perhaps as much strength and tenacity as to hold the edges of a wound together, with all the required firmness and strength of sutures. When a film of it is placed upon the skin, and is allowed to dry thoroughly for a few minutes, the subsequent attempt to separate it is like peeling and tearing off the epidermis after erysipelas, &c. It then forms, as it were, at once a kind of artificial tissue, epidermis, or skin, which adheres strongly for a time. There is one disadvantage pertaining to it. In the course of a day or two it generally

dries and crisps up, like court plaster, at its edges. If we could either increase its adhesiveness, or destroy its tendency to dry and crisp, we should render it more useful. I have seen the addition of a little caoutchouc apparently correct it in these respects.

The deposit or "plaster" left by the solution of gutta-percha is far more equable, smooth, and skin-like, than that left by the solution of gun-cotton.

A solution of caoutchouc in bisulphuret of carbon, ether, or chloroform, leaves a very thin, but perhaps less regular web, and one which stretches too readily for most practical purposes.

One great defect in this class of dressings is the want of a menstruum sufficiently powerful, and, at the same time, not stimulating like ether or chloroform. This objection may, perhaps, in practice be got over, by applying an unstimulating solution of isinglass or the like to the raw surface, before applying the stimulating solution of the gun-cotton or gutta-percha. Or the first layer of gun-cotton or gutta-percha may be made very thin, so as to evaporate almost instantaneously, and then afterwards a series of superincumbent layers may be added till the web is of the required strength. Other better substances for solution may, perhaps, be found. But no material has a chance of succeeding, unless it be insoluble in water after it is consolidated, and unless it be sufficiently strong in its texture, and possesses powerfully adhesive properties.

[Dr. Simpson has forwarded to us the following addition to the report.]

P.S. Since the preceding observations were published in the Monthly Journal of Medical Science for July last, various attempts have been made by Messrs. Duncan, Flockhart, &c., to improve the manufacture of collodion or gun-cotton solution. For some time past they have thrown aside other formulæ, and use now only that of M. Mialhe (described in the present volume of the MEDICAL GAZETTE, p. 517). They find this formula by far the most simple and certain that they have tried. The sulphuric acid employed should be the commercial kind; as, when it is too strong and concentrated, it chars and blackens some of the cotton, making a dark instead of a transparent solution.

Edinburgh, Oct. 1st, 1848.

